PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Diet Supplements containing Dextran

We, THE COMMONWEALTH ENGINEERING COMPANY, of Ohio, a corporation organized and existing under the Laws of the State of Ohio, United States of America, of 1771, Springfield Street, Dayton, Ohio, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement: —

This invention relates to diet supplements containing dextran.

A number of substances and compositions have been widely advertised as weights reducing or controlling aids. Most of the products advertised for that purpose are not of natural or biological origin and many of them are not recommended by physicians because they are drugs capable of inducing side-reactions or side effects such as hormonal imbalances which vary with the individual and are unpredictable.

Other types of materials put forth as reducing agents, and also of non-biological origin, such as carboxymethyl cellulose, function only indirectly to control weight gain by adding bulk to the diet which tends to allay hunger pangs.

One object of this invention is to provide a harmless dietary supplement to be ingested orally and which directly inhibits increase in body weight.

This and other objects are accomplished by supplementing an appropriate diet with native, unhydrolyzed water-soluble, linear or substantially linear dextran.

The dextran produced under conventional conditions by the action of dextran-producing strains of *Leuconostoc* on sucrose present in an aqueous nutrient medium also containing appropriate inorganic salts is known as native dextran and has a molecular weight in the millions as estimated from light scattering measurements.

Native dextrans having different structural and physical characteristics are known.

I have established, by biological test, that only those native dextrans which are water-soluble, linear or substantially linear, and in which 94% to 97% of the linkages joining the anhydroglucose units are 1, 6 linkages have the property of effectively inhibiting gain in body weight when ingested orally as a diet supplement. I have established by the biological test that the property of effectively preventing or minimizing gain in body weight is exhibited by even these specific and particular native dextrans only when the diet is substantially free of sugar.

Sugar-free diets, if adhered to for a sufficiently long time, usually result in loss of weight. However, the biological tests show that the control over body weight is much more pronounced when a dextran having the characteristics described above is taken as supplement to a sugar-free diet than when the dextran supplement is omitted.

The dextrans which meet the present requirements are those native dextrans produced by microorganisms bearing the following NRRL (Northern Regional Research Laboratory) designations: *Leuconostoc mesenteroides* B-1146, B-1064, B-1119, B-512, B-1066, B-1414. All of these dextrans are highly linear, water-soluble, and contain 1, 6 linkages to the extent of 94% to 97% of the total linkages.

The tests show that water insoluble, more highly branched dextrans such as are typified by *L.m.* B-523 and *L.m.* B-1120 dextrans, are ineffective as weight controlling aids.

It is believed that the specific native, linear or substantially linear, water-soluble dextrans are effective weight controlling aids because, due to their structural characteristics, such dextrans resist degradation by enzymes and bacteria existing in the gastro-intestinal tract.

These native dextrans comprise extremely large molecules which exert a definite osmotic pressure. Being only slowly metabolized and resistant to depolymerization by the enzymes and bacteria, these particular native dextrans tend to retain their initial high molecular weight during passage thereof through the digestive tract, and thus tend to retard the absorption and assimilation of food nutrients. This in turn influences the extent to which any substantial gain in body weight is observed when the dextran is ingested at intervals over a period of time and in conjunction with an otherwise essentially sugar-free diet.

These particular, water-soluble, highly linear dextrans are film-forming. That property and the dissolution of the dextran in water present in the gastro-intestinal tract, are also believed to have an important bearing on the effectiveness of these dextrans as stabilizers of body weight. The dissolved, high molecular weight dextran can form a protective film or coating on undigested food particles or droplets present in the gastro-intestinal tract. Food particles thus coated with a film of the dissolved linear dextran are protected from enzyme attack because degradation of the protective dextran film is required first, and these dextrans are strongly resistant to enzyme degradation.

It is believed that on the basis of present knowledge and observation, the protective dextran film, by delaying or preventing access of the enzymes in the gastro-intestinal tract to the food particles or droplets, which access is required for break-down of the particles and droplets into assimilable and absorbable nutrients, slows down the normal assimilation and absorption processes. This would tend to have the effect that, when these dextrans are eaten as diet supplement, the energy resulting from the assimilation and absorption of the food nutrients is expended in the performance of normal activities substantially as it is generated, without storage as excess fat. The dextrans, therefore, directly influence and control the body weight of the individuals who consume them.

For some reason not presently clearly understood, the dextrans do not exert the weight controlling effect or exert it to a much less pronounced effect when the diet contains sugar. These dextrans are to be used, therefore, in conjunction wtih sugar-free or essentially sugar-free diets.

The effectiveness of the linear, water-soluble dextrans as body weight controlling aids has been proved by biological tests. In one series of tests carried out on rats, the results shown in Tables I and II below were obtained. The data of Table I was obtained by feeding, ab libitum, two groups A and B each made up of the same number of weanling male albino rats the same diet (the normal protein test diet produced by General Biochemicals, Inc., Laboratory Park, Chagrin Falls, Ohio), except that the daily diet of the animals of Group A was supplemented by 5.0% by weight (based on the weight of the diet fed to the rats) of native *L.m.* B-512 dextran.

To obtain the data in Table I, each animal of Group A and each animal of the control group B was weighed periodically and the total weights for each group were averaged and plotted against the number of days the animals had been on the respective diets.

After 35 days, during which the rats were free to move about, it was established, as is apparent from a study of Table I, that although some gain in weight as the rats matured had to be expected, the weight gained by the maturing rats of Group A and which had been fed the basic diet supplemented by the dextran was considerably less than the gain in weight by the maturing control rats.

TABLE I

Days on Diet	Total % Weight Gain Group A	Group B
3	20	28
5	30	38
8	45	60
13	68	88
22	100	135
35	180	275

Except for the difference in their weights, the gross appearance of the rats of Group A was the same as that of the control group. Some of the rats of Group A were sacrificed at the end of the 35-day test period and histological sections were prepared from their liver, spleen and kidney. Examination of these sections proved that the weight control had been effected by the dextran without harmful structural or pathological tissue changes.

In order to determine the effectiveness of dextran in controlling the weight of mature individuals, and also to demonstrate that the results summarized in Table I for group A are directly attributable to the dextran supplement, the diets were reversed, after the 35-day period. The rats which had been fed the dextran-supplemented diet (Group A in Table I, Group C is Table II) were fed the straight protein diet while those which had been fed the straight protein diet in the initial phase of the test (Group B in Table I; Group D in

Table II) were now given the protein diet plus the 5% by weight dextran supplement. The animals in both groups were again weighed at intervals, with the results shown in Table II.

TABLE II

Days on Diet	Total % Weight Increase Group C	Group D
11	275	340
21	378	460

As is apparent from Table II, the rats which had gained only an average of 180% during the 35-day period on the dextran-supplemented diet, increased in weight by an additional 280% when they were taken off the dextran-supplemented diet and fed the straight protein diet for three weeks. In contrast to this, the animals which had gained an average of 275% in weight during the 35-day period on the straight protein diet, showed only an additional increase in weight of 103% when fed the dextran-supplemented diet for three weeks.

The results of these experiments are illustrated graphically in Figure 1 of the attached drawing.

Other tests were carried out to determine the effect of sugar on the effectiveness of these linear dextrans for controlling body weight.

In one series of such comparative tests, weanling male albino rats were divided into seven groups each consisting of 5 to 6 individual rats. The different groups were fed water and the diet shown below.

Group No.	Diet
1	Control Standard Protein test diet produced by General Biochemicals, Inc. (Diet SPTD)
2	SPTD plus 5% native B-512 dextran
3	SPTD plus 5% native B-512 dextran plus 5% sucrose
4	SPTD plus 5% native B-1120 dextran
5	SPTD plus 5% native B-1120 dextran plus 5% sucrose

The rats were weighed periodically. The results of this series of comparative tests are shown in Figure 2 of the accompanying drawing, which consists of curves obtained by plotting the percentage gain in weight against the time in days during which the rats were fed the particular diet indicated.

As will be observed, the rats fed the plain control (SPTD) protein diet gained weight progressively. Those maintained on the SPTD diet plus 5% of the native, water-soluble, linear B-512 dextran, gained much less weight, and the gain was only a normal expected gain attributable tothe natural maturing of the rats. The weight gained by the rats fed the SPTD diet plus 5% of dextran and 5% of sucrose was much greater than that gained by the rats on the sugar-free, dextran+SPTD, diet showing that in the presence of sucrose the dextran is inhibited from exerting a controlling or retarding effect on body weight gain.

Rats fed SPTD diet plus 5% of *L.m.* B-742 dextran, which is a non-linear, comparatively highly branched dextran of which only 67% of the linkages joining the anhydroglucose units are 1, 6, gained significantly in weight as compared to the rats on the simple SPTD diet.

The most pronounced gain in body weight was shown by those rats fed the SPTD diet plus 5% of the water-insoluble, branched dextran B-523, of which only 66% of the linkages are 1, 6.

It was also observed during the investigations of the effectiveness of the highly linear, water-soluble dextrans for inhibiting or minimizing gain in body weight, that these particular dextrans also exert a laxative effect. The excrement of the test subjects was bulkier than for the groups fed the straight SPTD diet.

For the present purposes, the native water-soluble, highly linear dextran is obtained by inoculating the sucrose-containing nutrient medium with the appropriate selected bacterial strain as indicated herein, incubating the mass under the conventional conditions, precipitating the native dextran from the fermentate, purifying the dextran, and preferably reducing the same to a fine powder as by spray-drying an aqueous solution thereof.

The native, water-soluble, highly linear dextrans which constitute the diet supplement of this invention may be prepared in various forms for oral ingestion. The dextran may be taken as a powder admixed with foods and beverages, or compounded in pill, pellet, or tablet form. It may be packaged in edible capsules or be used as a water-soluble coating for a chewable pellet, such as chiclets (Registered Trade Mark).

These dextrans may be incorporated in cereals of all kinds and in any non-sugar containing foodstuff. The dry dextran powder or a soltuion thereof may be sprinkled on vegetables and meats, mixed with salads or salad dressings. These native, linear dextrans are bland, essentially tasteless, non-toxic, non-irritating substances. Incorporated as such in foods, beverages they do not alter the flavor,

odor or other characteristics thereof. They may be compounded with flavoring adjuvants or spices, if desired. For example, the dextran may be admixed with special dietetic foods, or it may be mixed with table salt, etc. for use in cooking or at the table.

It is contemplated that, for the purpose of stabilizing body weight and maintaining a more or less even balance between energy created and energy expended in the course of normal adult activities, the enzyme-resistant dextran will be ingested regularly, on a definite schedule or regimen such as at least once daily, and in an amount sufficient to stabilize the body weight or prevent any significant gain in body weight, and will be a staple dietary factor or supplement for a time period which may be prescribed.

In any of these embodiments, the dextran may be compounded with other dietary factors such as vitamins, minerals.

These native, linear, specific dextrans, by inhibiting absorption and assimilation of undigested food nutrients in the gastro-intestinal tract, serve to reduce or limit the amount of weight gained on the given-essentially sugar-free diet.

Relatively large amounts of these dextrans may be consumed safely, but the daily dosage will usually be from 0.5% to 10% by weight, based on the weight of the daily food (including beverage) intake, or as prescribed by a physician. If the dextran is taken at intervals throughout the day, for example in conjunction with meals, the individual "doses" may be proportioned so that the total amount of dextran consumed does not exceed the prescribed daily dosage.

Compositions comprising the dextrans and food nutrients, may be regarded as special dietetic foods for oral ingestion at intervals over a period of time longer than, say, 24 hours and which may be indefinite, for assisting those individuals who tend to gain weight over that considered optimum for their height and bone structure to stabilize and control their weight without resort to stringent dieting or the use of drugs. These dextrans will be found useful in dietetic foods for consumption at regular intervals, and at least over a substantial period of time, as weight control adjustment in the diet of those who tend to obesity or to gain weight as a result of normal or even abnormal food intake, or who normally tend to metabolize food more rapidly than the resultant energy is expended, and thus tend to excess fat accumulation. These special dietetic foods will indirectly safeguard health by reducing the incidence of diseases to which individuals who are substantially overweight or obese are susceptible. The dextran may be incorporated in stock feed when, for any reason, it is desired to prevent excess weight gains in animals.

It will be apparent that the discovery that the specific and selective native dextrans defined herein are highly effective in inhibiting gain in body weight by individuals observing a diet which is high in protein and essentially sugar free and that such inhibition of gain in body weight is exercised by these biologically derived dextrans without harmful side-effects, is of great importance in connection with the problems of those individuals who tend to gain excessive weight or incline to obesity.

WHAT WE CLAIM IS:—

1. A dietetic food to be orally ingested at intervals over a period of time and comprising, in admixture, essentially sugar-free food elements that are normally assimilated and absorbed in the gastro-intestinal tract and, for inhibiting gain in body weight, native, unhydrolyzed, water-soluble, substantially linear dextran of which 94% to 97% of the linkages joining the anhydroglucose units are 1, 6 linkages.

2. A potable essentially sugar-free liquid to be consumed at intervals over a period of time and having dispersed therein, sugar-free foods admixed with native, unhydrolyzed, water-soluble, substantially linear dextran of which 94% to 97% of the linkages joining the anhydroglucose units are 1, 6 linkages for inhibiting gain in body weight.

3. A diet supplement to be ingested orally at intervals over a period of time and comprising a capsule of edible, essentially sugar-free material enclosing a body weight stabilizing and controlling agent comprising native, unhydrolyzed, water-soluble, substantially linear dextran of which 94% to 97% of the linkages are 1, 6 linkages.

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Agents for the Applicants.

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Fig. 1

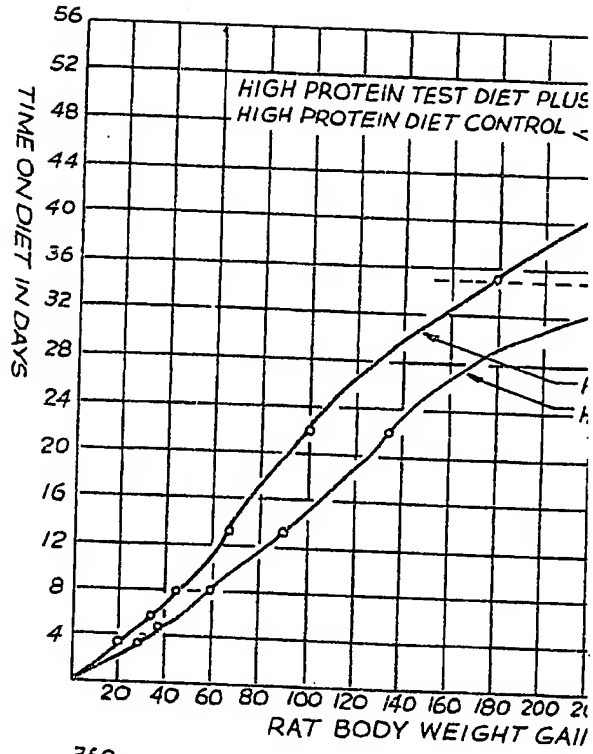
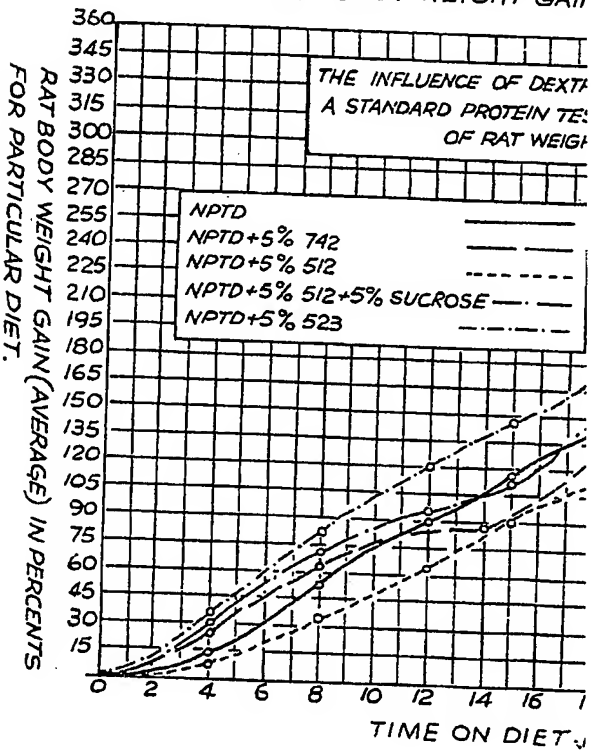

HIGH PROTEIN TEST DIET PLUS
HIGH PROTEIN DIET CONTROL
TIME ON DIET IN DAYS
56
52
48
44
40
36
32
28
24
20
16
12
8
4
20 40 60 80 100 120 140 160 180 200
RAT BODY WEIGHT GAI

Fig. 2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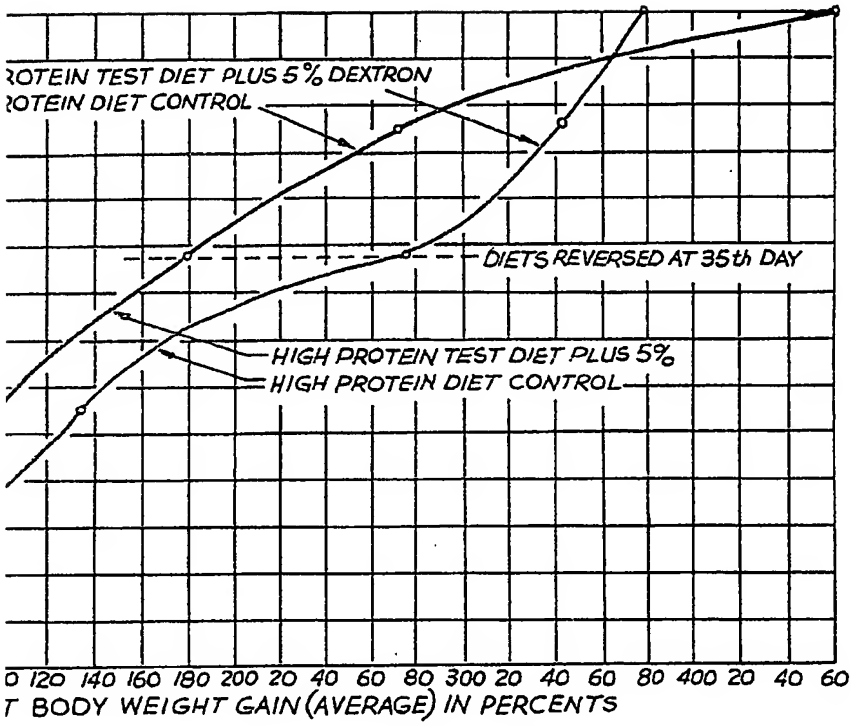
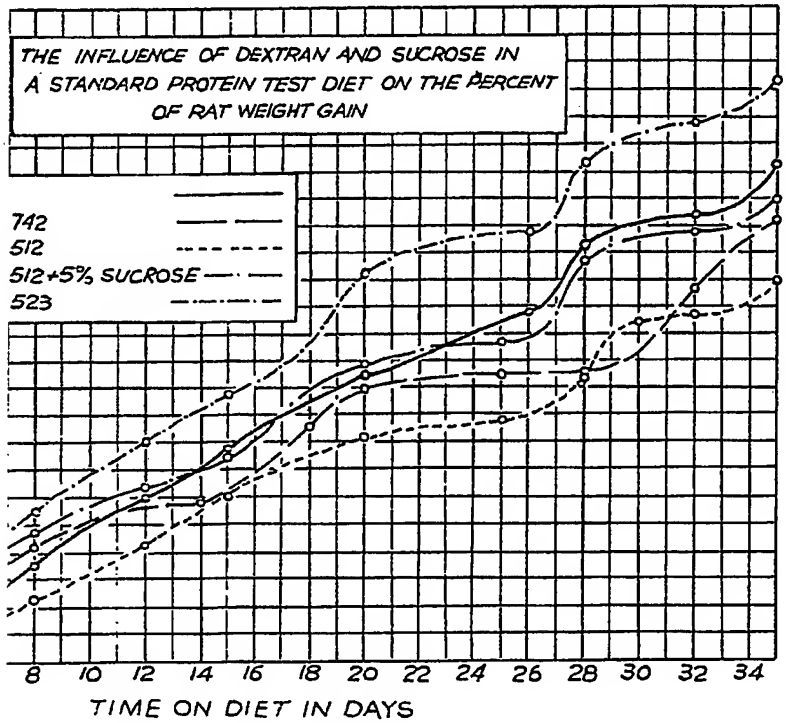
A STANDARD PROTEIN TE
OF RAT WEIG
NPTD
NPTD+5% 742
NPTD+5% 512
NPTD+5% 512+5% SUCROSE
NPTD+5% 523
RAT BODY WEIGHT GAIN (AVERAGE) IN PERCENTS FOR PARTICULAR DIET.
360
345
330
315
300
285
270
255
240
225
210
195
180
165
150
135
120
105
90
75
60
45
30
15
0 2 4 6 8 10 12 14 16
TIME ON DIET

830,951 COMPLETE SPECIFICATION
1 SHEET

This drawing is a reproduction of the Original on a reduced scale.





830,951 COMPLETE SPECIFICATION
1 SHEET

Fig. 1

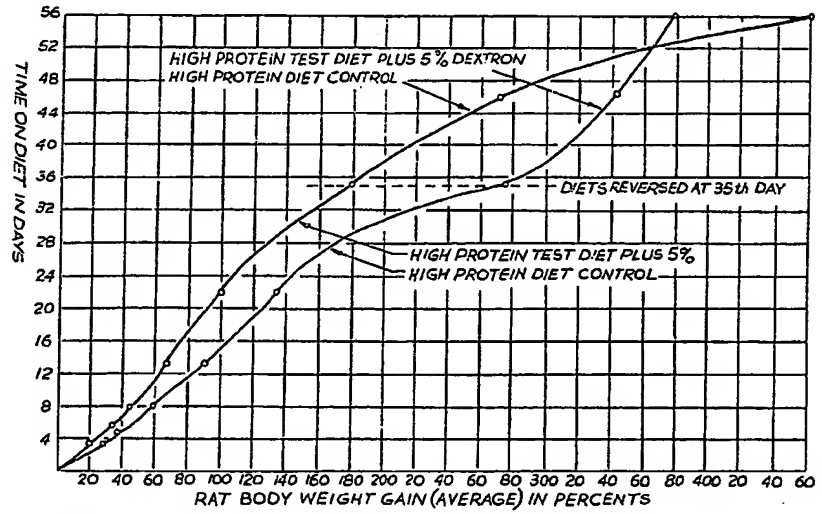


Fig. 2